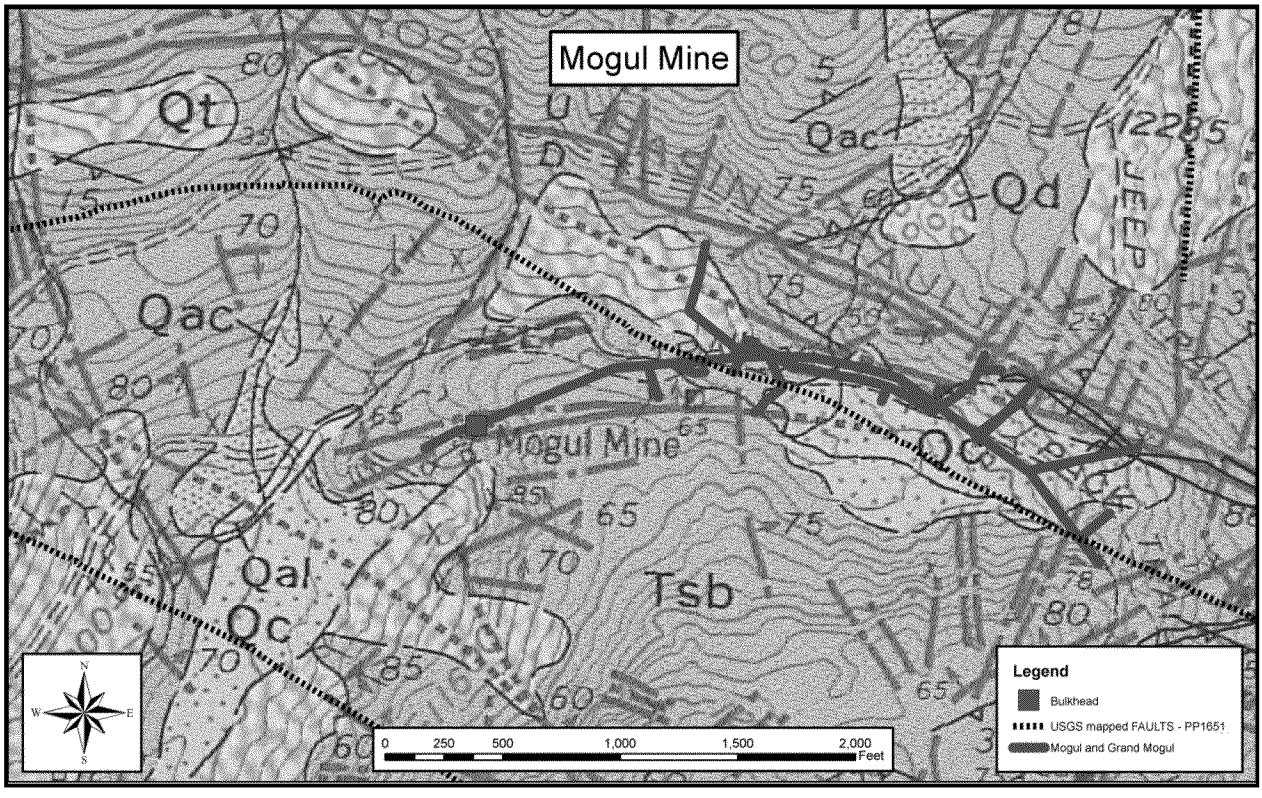
Mogul Mine Geologic and Hydrologic Investigation

Colorado Division of Reclamation, Mining and Safety

Proposed Scope of Work

The focus of the Mogul Mine investigation is a preliminary assessment of the geologic and structural characteristics of the Mogul Mine to assess the feasibility of pressure grouting the rock formation around the Mogul Bulkhead to prevent leakage around the bulkhead.



Field mapping of structural features and geology, seeps and springs, and other mine openings will be completed in the summer of 2015 by Kirstin Brown and Allen Sorenson from Colorado Division of Reclamation, Mining and Safety.

Strike and dip data of surface fractures and faults will be collected in the vicinity of the Mogul mine workings as projected up to surface. The Mogul Mine is driven on a near vertical fault that branches off from the larger Ross Basin Fault. The bulkhead is located within this sub-fault area at 241 feet from the portal . The width of the sub-fault zone will be determined through surface geologic mapping to help guide the lateral extent of drilling and grouting that may be necessary. Underground mapping of the Mogul Mine will completed up to the bulkhead location, collecting strike and dip data from underground along the ribs and back of the tunnel. The strike and dip data will be analyzed to indicate any trends in the direction of structural features inside and outside the tunnel. The trends will be used

to determine the feasibility of pressure grouting the rock formation. The geology of the area will also be examined in detail on the ground and through literature review of existing reports and maps.

Seeps and springs data will be collected around the Mogul, using flow measurements and pH and conductivity as a guide to understand the water. As part of this data set, the stope that is connected to the Mogul workings will be located, water depth measured to determine the head of the mine pool and a water sample collected to represent mine pool chemistry if appropriate. The seeps and springs data will indicate the general direction of water flow through the subsurface, further enhancing the understanding of the structural connections of the groundwater with the surface. Additionally, underground seeps data will be collected inside the Mogul Mine to determine the location, water quality, and chemistry of in-flows along the tunnel invert. The seeps and spring data collected will be used as baseline data if pressure grouting or another best management practice is completed in the future.

Other mine openings will be accurately located in the field using a Trimble ProXRT and compared with available mine maps to gain an understanding of the connectivity with other mine openings, either through direct connections or through structural features that could serve as potential groundwater connections. Many of the Mogul Mine maps have already been collected and scanned as part of the mine workings modeling completed by DRMS and BLM, but another search for Mogul Mine maps will be done to ensure the most accurate mapping. The mine workings and geology will be mapped in three dimensions in earthVision to better understanding the workings vertical connections, groundwater levels, and geology as they relate to the mine openings in the vicinity of the Mogul.

Mine opening(s) connected to the Mogul will be assessed for potential groundwater elevation increases caused by grouting the formation around the bulkhead. Connected mine opening(s) will be documented and the feasibility of installing seals in the openings will be assessed. The feasibility of future seals in vertical openings will be determined by rock quality, opening size, expected head pressure increase, construction access considerations, and morphology of the mine workings.

All existing reports on the Mogul and vicinity will be compiled and summarized as part of the background of the report, which includes, but is not limited to the following:

- Bulkhead Design Documents for the Mogul
- DRMS Permit Information
- Mine maps from the Sunnyside collection, if not already scanned
- Structural Data from Sunnyside mapping efforts
- USGS geologic maps, reports and water quality data
- USGS PP 1651 and all associated mapped data
- EPA water quality sampling data
- ARSG water quality data - including historic CDPHE data

Budget:

Kirstin's Time: 220 hrs *$52/hr = $6,240.00
Allen's Time: 130 hrs * $70/hr = $5,600.00
Water Samples: 15 samples max * $250/sample = $2,500.00
TOTAL: $24,290.00

Deliverables:

- Final Report - The final report will include a determination of the feasibility of pressure grouting the rock formation around the bulkhead. Brief recommendations will be provided for pressure grouting, to later be expanded on in a design, if grouting is selected as the preferred best management practice. The potential for installing seals in connected mine opening(s), should the groundwater level increase above the height of the opening, will be assessed. The final report will be complete by January 31, 2016.

- All data - shapefiles of strike and dip measurements, all relevant GIS data compiled into one database for the site, all mine maps, and shapefiles of mine workings. All cited reports will be digitally compiled. The compiled data will be delivered with the final report.

- Three dimensional model of the groundwater, mine workings and geology around the Mogul will be delivered with the final report.